Man and His Environment

Occasional Paper No. 6

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Man and His Environment

by the late Prof. Harry G. Johnson
With a Commentary by Frances Cairncross

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BRITISH-NORTH AMERICAN COMMITTEE (BNAC)
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The British-North American Committee

At the Committee's first meeting in New York City, December 1969, the following statement of its aims was authorised:

> *The British-North American Committee has been established to study and comment upon the developing relationships between Britain, the United States and Canada. It seeks to promote clearer understanding of the economic opportunities and problems facing the three countries, to explore areas of cooperation and possible friction, and to discover constructive responses. It believes that sound relations between these three countries in the context of an increasingly inter-related world are essential to future prosperity and seeks to promote better understanding through the collection of facts and their widespread dissemination.*

During the 20 years since then, the Committee has broadly maintained these aims and has sponsored a series of objective studies undertaken by qualified experts in three countries and published with the Committee's approval. On the basis of these factual studies and of discussions at its meetings, the Committee has also issued policy statements signed by its members.

The diversity of issues that the BNAC has addressed is shown by the 43 titles listed at the back.

The Committee's membership includes business, banking, labour, agricultural, and professional leaders from the United Kingdom, the United States and Canada. The Committee is sponsored by three non profit research organisations — the British-North American Research Association in London, the National Planning Association in Washington, and the C.D. Howe Institute in Toronto.

The BNAC is a unique organisation both in terms of its broadly diversified membership and in terms of the blending of factual studies and policy conclusions on issues important to the three countries. It meets twice a year, once in the United Kingdom and once in North America. Its work is jointly financed by funds contributed from private sources in the United Kingdom, the United States and Canada. Offices on behalf of the Committee are maintained at 1424 16th Street, N.W., Suite 700, Washington D.C. 20036, and at Grosvenor Gardens House, 35-37 Grosvenor Gardens, London SWIW OBS. Dr. Richard Belous in Washington is North American Director of the Committee, and Simon Webley in London is the British Director.

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Preface by the Joint Chairmen

Environmental issues are again high on the list of concerns in the United States, Canada and the United Kingdom. It is therefore to be expected that political leaders will be looking for effective responses to environmental concerns.

However, policy proposals have to take into account other reasonable concerns such as an improving standard of living, low unemployment, low inflation, and security among others.

Reconciling costs and benefits of different approaches is an age old problem and is not helped by the obscure language and mathematics sometimes used by experts. Nevertheless, we believe that one economist — the late Harry G. Johnson — was able to explain these difficult concepts in clear and simple language.

In 1973 the British-North American Committee (BNAC) first published Professor Johnson's study 'Man and His Environment'. As the environmental debate has intensified in recent years, members of the BNAC felt that this study has even more to say to us today than when it was first published. For this reason, we have decided to reissue it with a new introduction by Frances Cairncross of The Economist.

If the original paper was being published for the first time, we would probably have picked a different title! However, this, by and large, would be the only change that we would suggest: Harry Johnson's work has stood the test of time and we commend it to environmentalists, politicians and others concerned with the development of public policy in this field.

A.B. MARSHALL.
Co-chairman

WILLIAM I. M. TURNER,
Co-chairman

WILLIAM J. McDONOUGH
Chairman, Executive Committee

PROFESSOR HARRY G. JOHNSON
(1923-1977)

Professor Harry G. Johnson made fundamental contributions in advancing the frontiers of economic science. He was recognized internationally and mostly for his work in the areas of monetary and international economic theory. He was a prolific author, and even today ranks at the top of the economic fraternity in terms of the number of scholarly publications in learned journals. Professor Johnson was regarded as the Dean of Canadian economists. He also contributed widely to, and had a keen interest in Canadian economic policy.

Professor Johnson was born in Toronto, Canada. He was educated at Cambridge (B.A.), University of Toronto (M.A.) and Harvard (Ph.D.). He held permanant teaching positions at the University of Chicago (1957-77) and London School of Economics (1964-74). Professor Johnson edited or co-edited many prestigious economic journals, including: the Review of Economic Studies (1951-59), the Manchester School (1956-59), the Journal of Political Economy (1960-66 and 1970-77), Economica (1970-73), and the Journal of International Economics (1971-77).

Among Professor Johnson's books are: The World Economy at the Crossroads (1965), Economic Policies Toward Less Developed Countries (1965), Essays in Monetary Economics (1967), Comparative Cost and Commercial Policy Theory for a Developing World Economy (1968), Aspects of the Theory of Tariffs (1971), Inflation and the Monetarist Controversy (1972), Further Essays in Monetarist Economics (1973), On Economics and Society (1975), and Technology and Economic Interdependence (1975).

FRANCES CAIRNCROSS

Frances Cairncross is Environment Editor of 'The Economist'.

Contents

The British-North American Committee — inside front cover

Preface by Joint Chairmen — i
Biographical Sketch of Prof Harry. G. Johnson (1923-1977) — ii

Man and His Environment by Harry. G. Johnson

I. Introduction.

The Population Problem — 1
Natural Resources — 4

II. Some Elementary Economics of the Environment

The Environment as Capital — 6
Pollution and Production as Joint Outputs — 8
Property Rights in the Environment — 12

III. Economic Growth and the Environment

Population Growth and Food Shortage — 16
Economic Growth — 17
Growth and the Quality of Life — 18
Growth and Resources — 21

Commentary on Prof. Johnson's Paper by Frances Cairncross — 25

Members of the British-North American Committee — 33

Publications of the British-North American Committee — inside back cover

Man and His Environment

I. Introduction

The possibility of harmful interaction of one sort or another between man and his environment has been a matter of concern, off and on, in popular economic thinking since the time of the English classical school of the early nineteenth century. Indeed, the crude economic analysis of the members of the classical school set the stage, i.e., the intellectual framework, for the expression of such concerns ever since. And it is a matter for dismay, for anyone concerned with the proper design of economic policy, that contemporary alarmists on the subjects of the population problem and the environment rarely reach the level of economic understanding achieved by the classical economists, let alone the level accomplished by professional economists after a century and a half of further intellectual work on the refinement, amendment, extension, and generalization of the crude framework of analysis adumbrated by the classical school.

The Population Problem

Thomas Robert Malthus, whose initial aim was to rebut the utopian socialist ideas of William Godwin, laid down the principle that population tends to breed to the level of subsistence. Consequently, any efforts to ameliorate the lot of the common man would simply be soaked up in an expansion of the population until the "positive checks" of mortality and starvation brought the process to a halt. Malthus attempted to prove these propositions on the basis of the empirical assertion that population could grow by geometrical progression, whereas agricultural production could increase only by absolute progression, so that the former must inevitably overtake the latter.[1] In fact, however, Malthus's argument was factually incorrect for his own time, since an immense improvement in agricultural productivity occurred, which laid the basis for the industrial revolution both by providing an agricultural surplus capable of sustaining large-scale industrial activity and by displacing workers from the land

[1] That is, population grows according to the series:
$1, 1+p, (1+p)^2, (1+p)^3, (1+p)^4 \ldots (1+p)^n$
whereas agricultural output grows according to the series:
$1, 1+a, 1+2a, 1+3a, 1+4a, \ldots 1+na$
It is obvious that regardless of the sizes of p and a, provided both are positive, $(1+p)^n$ must exceed $1+na$ for large enough n.

into industrial employment. Moreover, Malthus's argument was theoretically crude, since it did not allow for feedback from population growth into the development of superior food-producing technology. Nevertheless, calculations of equal crudeness - although sometimes dressed up in high-powered statistical or econometric computations - remain characteristic of the literature on the "population problem" and a prospective "food crisis" and "ecological crisis."

In analyzing the prospective population problem, Malthus initially put his emphasis on the "positive checks" that increasing misery would impose on population growth. But, by the time of his second essay, he was de-emphasizing the inevitability of a population problem, stressing instead the "negative checks" of deferred marriage, continence in copulation after marriage, and other indirect methods of birth control that Christianity and the absence of a birth control technology suggested.[2] The result was to make the pressure of population on natural resources an analytical possibility arbitrarily and gloomily selected for theoretical emphasis, rather than a presumptive empirical fact. This characteristically plagued the efforts of Malthus's contemporaries and immediate successors (including Marx) to build their theories of distribution and growth on an assumed tendency of labor to breed to the level of subsistence (the so-called iron law of wages). The experience of steadily rising real wages in the western world for at least the past three-quarters of a century, in spite of significant rates of population growth, strongly suggests that population does not blindly over-breed in relation to available natural resources (especially given the rapidly increasing availability of contraceptive information and techniques). People respond to the increasing availability of natural resources, and of economic opportunities generally, partly by raising their own standard of living and partly by raising more children. But - and this is a very important point - they raise their children to their own standards of education, living and health, and do not simply cast them out eventually into the world as unskilled labor. This experience also suggests that, in due course, reproduction customs will become

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[2] This, in fact, gave rise to the first birth control movement, which consisted of efforts to persuade the working class to exercise family limitation in order to improve their economic lot and standard of living. The second birth control movement was aimed at teaching middle-class women to liberate themselves from child bearing for economic activities by using newly developed contraceptive devices, and has culminated in the widespread use of oral contraception in our time. The third birth control movement, of recent origin, has been aimed at poor people in less-developed countries, and has encountered serious difficulties, on the one hand, with social motivations for procreation deriving from considerations of social status and economic security, and on the other, with the expense of contraceptive devices and the absence of the sophistication required to use them effectively.

It may be noted that contraceptive techniques have been known and used among upperclass women at least since Roman times. The problem has been to devise and popularize techniques for the masses, not the classes.

the same in the less-developed countries as economic opportunities and knowledge of opportunities and birth control methods spread; and that, consequently, alarmist fears of population pressing on natural resources are unjustified, and the computations used to support these fears equally unjustified.[3] It is not logical to make projections of the future on the assumption that population behavior is completely independent of available resources and of human aspirations for improvement, when a wide range of human history — and not merely the recent history of a technologically advanced and highly educated western world — points in the opposite direction.

On the other hand, however, there are some obvious cases in which the private costs of having children fall well short of the social costs, thus creating private incentives to excessive population growth. In the advanced countries, these cases typically involve the assumption by the public, through the state, of a large part of the cost of child-bearing and child-rearing in the form of free or subsidized medical care, free or subsidized nutrition, and free or subsidized education. This creates a problem because these benefits are especially important to the poor, who could not otherwise afford the cost, and who also may lack the education and self-discipline required for rational family planning; hence, the tendency in developed countries to put increasing emphasis on the dissemination on contraceptive information as an integral part of antipoverty and social welfare programs. Similar factors are at work, to a smaller extent, in the less-developed countries. Additionally, a large reason for the motivation for aid-giving by rich to poor countries is moral shock at the existence of poverty in those countries. But foreign development aid reduces the private cost of population growth in those countries, both by providing economic and medical support for children once born and by widening subsequent employment opportunities, and so may in whole or in part defeat its own aim of mitigating manifest poverty.

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[3] It is necessary here to distinguish between the alleged prospective pressure of population on food supply, and the prospective pressure of population on resources in general. The classical analysis rested on an assumed absolute limitation in the amount and fertility of available land, and a consequent pressure of increasing population on the producible food supply. This assumption that food is the limitational factor has been repeatedly falsified by the development of new technologies of food production and of substitution of other items for food, such as better warm clothing, central heating, and more indoor and sedentary occupations. Technological developments have also, in effect, added to the amount of agricultural land available to feed people. Introduction of the internal combustion engine released vast quantities of land and agricultural output previously used to feed animals. On the other hand, expansion of population at a constant standard of living, given technology, usually requires a more or less proportionate expansion of the stock of capital (exception being made for the possibility of switching to less capital-intensive types of products), and hence uses up savings that could otherwise be available for increasing capital intensity, or educational levels, on the level of technology. Thus, rapid population growth increases the difficulty of alleviating poverty. But the reason is not shortage of food or of nonagricultural natural resources per head, but shortage per head of resources in general.

The easiest way to eliminate manifest poverty is to prevent the poor from being born in the first place; the hardest way is to encourage them to be born and then try to remedy the results. Hence, the mounting concern of those involved in development assistance, and in development planning, for programs of population control.

Natural Resources

Malthus was concerned with the tendency of population to breed to the level of subsistence, and laid the foundations of the current concern about the population problem. David Ricardo, on the other hand, was concerned with the distribution of national income among the social classes of landlords, workers and capitalists, and with the effects of economic growth on this distribution. For this purpose, he accepted the "iron law of wages" (although he made the concept of subsistence wages a matter of social convention and therefore theoretically indeterminate) and made the determinant of the effects of economic growth on distribution, and especially on the rate of profit as the incentive for capitalists to save and accumulate capital, the assumed absolute fixity of "the original and indestructible properties of the soil." In modern terminology, man's capacity to enjoy a high standard of living is limited by the fixity of the natural resources available to him, and depends on the number of men relative to the available amount of natural resources.

One corollary of this proposition, discussed in the previous section, is the conclusion that man can destroy his economic well-being by over-breeding; coupled with the assumption that man will automatically tend to over-breed when left to his own devices, the proposition leads to the conclusion that avoidance of human disaster requires strong programs of population control.

The other corollary is the proposition that, if a fixed stock of natural resources sets the limit to man's potential economic welfare, *and* if the present generation of men has any concern for the economic welfare of its progeny, it is the obligation of the present generation to preserve the stock of natural resources intact for the use of future generations. (It should be noted here that the presumed obligation of the current generation to preserve the environment is an unsupported social judgment, not necessarily constituting rational self-interested economic behavior. One might well argue, instead, that "I had to cope with the environment my parents chose to leave me, let my children do the same.") This corollary has expressed itself in the past in the "conservation movement," i.e., the movement to prevent by legislation the depletion of existing natural resources such as (most typically) forests by lumbering, mineral deposits by mining, and agricultural land by cropping that destroys the fertility of the land.

More recently, it has expressed itself in the "antipollution" and "environment-preservation" movements. In all of these movements, there are elements of the Ricardian assumption that there is something special about the environment that requires keeping it intact in its existing form.

The Ricardian assumption was doubtless convenient to Ricardo as a means of striking through the complexity of reality to the basic principles of resource allocation and the distribution of income. But, as a specification of economic reality, it is extremely naive and misleading. Man's whole history has been one of transforming his environment rather than accepting its limitations. He has domesticated and raised animals for his own use rather than relying on hunting them, and previously he invented weapons for hunting them made from pieces of the environment rather than relying on his original physical powers. He has cleared ground for the planting of crops rather than relying on what he could collect from nature's rather niggardly abundance. And he has steadily shifted his economic activities from an overt and direct reliance on using products made available by nature to organizing those products, or those sophisticated by human ingenuity, into an industrial productive system which, directly at least, is completely independent of nature's bounty. It is true that we still have problems of local famine due to crop failures; but these are typically associated with lack of adequate local storage facilities and the difficulties of transporting food from areas of abundance to famine areas rather than to real, overall world shortages. Similarly, we still have earthquake and flood disasters; but, except in remote parts of the world, these disasters are usually the result of taking a calculated risk on how much of nature's potential depredations it is worth while ensuring against by investment in the reconstruction of the environment through such means as building earthquake-proof housing, shops and factories, and constructing river-control and irrigation systems.

The crucial question, therefore, does not concern the transformation of the environment by man, and the presumptive undesirability of this transformation per se, but whether certain types of transformation have undesirable results, in the sense of worsening man's potential welfare. Analysis of this question raises much the same fundamental issues as analysis of the population question — specifically, whether the private costs and benefits of the environment- altering activity (in the population case, procreation) reflect social costs and benefits closely enough for private choices to approximate the choices that an all-wise, centralized social decision-taking process would make. However, there are some special aspects of the problem which economists have been particularly concerned with in recent years; these pertain to the definition and exercise of property rights in the environment, and will be discussed in the next chapter.

II. Some Elementary Economics of the Environment

The Environment as Capital

As already mentioned, Ricardian economics made the environment, in the form of "the original and indestructible properties of the soil," the basic capital that society had to work with, and the limiting factor in man's ability to improve his economic lot by accumulation of material capital in the form of factories and machines. This way of looking at the environment was natural enough for a society with what appeared to be a static technology of agricultural production and a static technology defining both what minerals and other natural resources were valuable enough to be worth extracting and the techniques for extracting them. But, in the context of contemporary society, natural resources derive their value from the available technology which is itself a variable alterable by investment in the creation of new technology itself, and from investment in transportation and distribution facilities. The environment, therefore, is a form of social capital which society must somehow manage if it is to maximize its welfare. From this point of view - the environment as a major part of society's capital - three crucial themes are apparent.

First, contrary to Ricardo, the environment is not "original and indestructible." On the contrary, it has built-in tendencies to self-destruction through such natural processes as the generation of forest fires by lightning, the erosion of soil by rainfall carrying it into the rivers and eventually the sea, and the gradual death of lakes through the sinking of sediment and the exhaustion of the oxygen content of the sub-surface water. More important, the economic value of the environment to man may be either augmented or destroyed by technical progress. Hence, wise social management of the environment may require *either* deliberate efforts to preserve and augment it, *or* deliberate efforts to transform the wealth that it represents into a more valuable form. Specifically, it may be in society's interests at one time to transform forest resources into cash, at another to preserve them as a form of future wealth; similarly, if a society possesses depletable mineral resources, it may or may not be advantageous to sell them or allow them to be used up in current production.

Second, but in the same vein, disinvestment in or depletion of the environment can generally (though not always) be corrected subsequently by investment. Forests can be replanted. Dead lakes can be revitalized by pumping oxygen into them, or the swimming and fishing facilities they formerly offered replaced by private or public swimming pools and commercial fish farms.

Similarly, metals removed from the ground can be recaptured as scrap and reprocessed — a procedure already characteristic of the iron and steel industry - and stores of energy sources such as coal and oil could probably be reconstituted with enough ingenuity or, in any case, substituted for by other means — for example, by the use of nuclear or solar energy — if it became necessary to do so.

These considerations point to two of the main weaknesses of many conservationist and antipollutionist arguments: their failure to consider the costs and benefits of transforming the environment, and their failure to consider the possibility of reconstituting the environment (or constructing a new environment catering to man's environmental desires) at a cost in terms of investable resources. Many of the favorite examples of these social critics are characteristic of these failures. For instance, the early settlers of Ontario counted on cutting down a tall tree and floating it downstream for sale as a mast to the British navy as a means of providing the cash with which to start farming; they also cut and stumped the other trees to make room for the growing of crops, thereby causing a soil erosion problem in the longer run. But the wealth they created in the process has enabled their modern successors to install tap water facilities, to plant trees and fertilize the soil they grow in, and to construct swimming pools to substitute more conveniently for the polluted rivers. This history makes a nonsense of alarmist views about destruction of Canadian forest resources. Similarly, Vance Packard's example of the using up of the world's iron resources in the manufacture of tin cans overlooks both the possibility of remelting scrap metal and the likelihood that if iron becomes scarce and expensive society will find some other way of packaging its preserved food (note that metal containers replaced glass containers because they were cheaper). Finally, while much has been written and said recently about pollution and congestion in the cities, no one who has read novels and histories or seen movies about cities in pre-modern times, with their narrow streets, their dumping of garbage and excrement in those streets to the peril of the passer-by, and their smog-creating methods of private heating, can doubt that the economic progress of humanity has been used in part to improve rather than to pollute the environment.

To say this is not to deny that problems of pollution exist. As will be argued in the next section, pollution is typically a by-product of production. The real problems, however, are two: what social arrangements are necessary to achieve the optimal combination of pollution and production, and which kinds of pollution constitute really serious problems in the sense that they are difficult if not impossible to correct subsequently. The first problem requires reference to both the stage of affluence of society and the distribution of property rights in the environment, to be discussed below. The second, which will be discussed only briefly here, requires a great deal of scientific knowledge and economic analysis not available at present. Put very briefly and broadly, as mentioned earlier,

forests can be replanted, soil re-fertilized, water de-polluted, and local air purified, although at a cost that may not be worthwhile, at least at current income levels. Alternatively, private individuals can plant their own trees, build their own swimming pools, and live in houses equipped with air purifiers and electrostatic dust precipitation, again if the cost is worth it. The crucial question is whether there are types of environment-destroying or pollutant activity that are not remediable within the bounds of present or foreseeable technology, economic resources, and governmental structure. It should be clear from the foregoing argument that most of the types of environment-destruction activity commonly complained of are remediable if this is desirable (which, it should be noted, it may not be). The types that come to mind as not being foreseeably remediable are those that have to do with common property resources of the world as a whole, where remedification might be too large a job to handle or where it might require an unprecedented degree of international cooperation. The specific examples are the pollution of the oceans (possibly also of lakes or seas on which several countries border) and the pollution of the upper atmosphere by jet aircraft. (It is difficult to envisage little men in space-suits armed with large nets attempting to retrieve jet fuel ash, yet the accumulation of this waste in the upper atmosphere is gradually altering the planet's weather). Various long-lived pollutants (e.g., heavy metals such as mercury and cadmium and synthetic organic chemicals such as DDT and PCB) that accumulate in the biosystem with unknown but possibly extremely hazardous effects also pose a serious problem. Society must decide whether the risks involved are worth the costs of forsaking use of these materials, considering the availability and costs of alternatives. Since the risks of using such materials will not be reflected in their price, the market cannot be expected necessarily to produce a socially optimal decision.

Pollution and Production as Joint Outputs

In a fundamental sense, pollution and production are joint products of man's efforts to transform his environment to his own use. ("Pollution" in this context is used for convenience to include destruction of the existing environment). For it is rare that the process of satisfying man's wants by environment transformation can both leave intact the environment from which useful products are extracted, and yield only useful products and no pollutant by-products. The production and consumption of goods inevitably involves the production and consumption of "bads."

This is true even at the most elementary biological level. The nourishment man requires to stay alive inevitably generates excrement. In primitive nomadic and agricultural societies, man merely returns the excrement to the environment, and conditions himself to ignore the resulting smells and unsightliness. In more

advanced societies, the disposition of excrement is collectivized in the form of running water and sewage systems; then the pollution of the water by the sewage becomes a problem, actual or potential.[4] More important for contemporary concerns about pollution and the environment, however, is the fact that the production of goods to satisfy man's wants involves the production of "bads" as a by-product. As a rough classification, "bads" are produced at three stages of the process of transformation of the environment into useful consumption goods: transformation of the environment into new materials and energy sources (using up of natural resources); transformation of raw materials into consumption goods (involving two types of "bads"— waste products, and the atmospheric pollution resulting from the consumption of energy sources); and the consumption of the goods themselves (garbage, litter, excrement, and atmospheric pollution resulting from the combustion of energy sources).

As will be discussed in the next section, the central problem raised by the joint production of "goods" and "bads" concerns the extent to which the consumers of the "goods" are obliged to recognize the joint production of the "bads" and consume them as part of the cost of consuming the "goods".

However, for purposes of the present argument, it is assumed that society collectively and not the individual consumer or producer of "goods" has to accept and put up with the joint production of "bads." To be more specific, it is assumed, for example, that production by a factory in a given location (e.g., a pulp mill or a coal electricity-generating plant) necessarily pollutes the air and the water (local river) supplies of the residents of the neighboring town. (In terms of the argument of the next section, the factory has the right to pollute the local environment). Society then has a choice, which it may exercise in this example either by prohibiting or encouraging the establishment of the factory in an existing town or by moving into or out of a town with a factory, between accepting or rejecting the package of "goods" and "bads" that result from the productive process.

The main relevant point here is that, faced with such a "package" choice, society might choose either way. The factory provides either more employment or better paid employment than is otherwise available; and it also provides goods that raise people's standards of private living.

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[4] In the early nineteenth century in England, there was a keen debate over whether the city sewage problem should be dealt with by the installation of running water systems or by provision of a service of house-to-house slop-pail collection. Running water won, and its victory led eventually to the problems of water supply and water pollution we now confront. The reader is invited to speculate on how different our society would be if sewage were handled the same way as garbage by household collection. He should note, however, that most if not all of contemporary problems concerning water are attributable to subsidized pricing of its use, and /or to charging a flat rate overhead cost for access to water supplies rather than (or without) a charge based on volume used.

On the other hand, to enjoy these benefits it is necessary to "consume" the "bads" that the factory creates in the way of environmental pollution. One would expect that in a generally poor economy — for instance, in a subsistence or a low cash, crop-producing agricultural economy, in which people are used to their own private pollution of their own private environments as a natural by-product of their existence and subsistence — the choice would be in favor of the factory. The benefits from producing and consuming the "goods" would be seen as outweighing the inconvenience of having to consume the "bads" as well.

Evidence of this can be found in the willingness of the average worker to accept the conditions of life — horrible by modern standards — in early post-industrialization cities, conditions well documented for England by a host of social critics and historians, and evident in contemporary times in the conditions of life in such cities as Tokyo. But one would also expect that as income-earning opportunities expanded, so that, on the one hand, as producers found it less and less urgent to earn the additional dollar per week, and, on the other, as consumers found it increasingly attractive to sacrifice marginal increments of consumption of material goods in return for enjoying a more pleasant environment, the choice would tend to go the other way. Either the establishment of the factory would be forbidden, or, if established, it would have to pay wages and salaries high enough to compensate its employees and those who earn their living by selling goods and services to its employees for the psychic cost of consuming the associated pollution or the material cost of offsetting the pollution.

The foregoing argument over simplifies matters by positing an all-or-nothing choice between nothing and a fixed bundle of production of "goods" and "bads". Actually, in most and probably all cases, the mix of "goods" and "bads" produced is a matter of technological choice; and the most profitable choice as dictated by the market opportunities confronting the firm can be altered by legal control, providing society is prepared to pay the cost of such control. Thus, for example, society can require that factories and households use smokeless fuel, or that factories dispose of their waste products harmlessly at their own expense instead of dumping them into the nearest river to the discomfort of downstream residents. But the public may not be willing to pay the resulting sacrifice of consumption of "goods" for the sake of reducing its consumption of "bads". Again, its willingness to do so will depend on its average income level, and the effects of this on its willingness to trade off more "goods" against less "bads".

The preceding argument is also over simplified by the implicit assumption that the public generally is aware of the nature of the "goods" and the "bads. " This assumption is unrealistic for two reasons. First, man is a fairly flexible and adaptable organism, capable both of adjusting to considerable variations in environmental conditions on a permanent basis, and of tolerating considerable short-run variations of his environment about the accustomed norm.

One can tolerate extreme heat or cold, extreme humidity or aridity, and extreme smog or dust in the air for short periods; and one also has biological mechanisms that will resist the penetration of germs and the communication of diseases. Hence, it is often extremely difficult to know when one's environment has become dangerous, i.e., when "bads" are being produced along with "goods." For example, in some locations with strong prevailing winds, high enough chimneys can get rid of smoke pollution; in others with low cloud covers, high chimneys make no difference at all, except in the minds of the local authorities and their engineers. Second, knowledge of the "bads" is easy for a society to acquire only if its technology is static and it can learn by experience, and institutionalize, how to minimize the ill effects of the "bads".

Primitive societies are characterized by an equilibrium in this respect: typically, certain parts of the environment are set aside for pollutant activities, and known by all to be polluted and therefore to be shunned except "on business." In a technologically advancing society, however, the pollutant byproducts of new types or methods of productive activity are unpredictable in advance, either in nature or in quantity or in both, and man has to learn by trial and error. This involves costs of a kind that would be avoidable if no changes could be effected without absolutely exhaustive prior research into all the alternatives, or if no changes at all were permitted; but the first stipulation would involve tremendous costs and delays and the second would put an end to human progress and the prospect of the betterment of man's lot on earth.

The relevant questions are whether the mistakes man makes in the process are remediable at all, and, if so, whether they are remediable in time to avoid human disaster. The first question was raised in the previous section, where it was suggested that most of the problems about the environment that concern alarmists are not problems in the sense of irretrievability of error, but that there may be some that are. However, to determine that issue would require far more scientific research into the potentialities of scientific research itself than is now available. The second question involves the economics of human response to error once recognized. Various arguments and empirical observations presented earlier in this essay suggest that there are strong grounds for optimism on this score. Mankind has steadily become better off — in terms of secular trend — since his origins on the planet, as measured by his capacity to support both increasing total numbers and a higher average standard of living for those numbers, in spite of the dangers implicit in the use of new and superior technologies for the transformation of his environment into more usable and gratifying means of self-support. There is no reason to think, in the light of millennia of human history and the consistent falsification of the prophesies of successive schools of doom predictors, that at the end of the third quarter of the twentieth century everything has suddenly changed, and man is doomed to be the victim of his incompetence to control and correct the consequences of his own ingenuity.

Property Rights in the Environment

The problems of pollution and environment destruction are intimately bound up with the question of property rights, including both their definition and the costs of enforcing them. This subject has been explored in detail by economists in recent years, following two seminal studies by H.S. Gordon and R.H. Coase. [5]

Gordon's article, which had particular reference to fisheries, showed that in the case of a "common property resource" (specifically, the oceans) for which no rent is chargeable and to which everyone has free access, there will be overuse of the resource, since private users will carry the use of the resource up to the point where the average return, including the share of the uncharged rent on the resource collected by the user, is equal to the average rent of exploiting the resource paid by the user (which does not include the uncharged rent). In short, if everyone has the right to fish in any river or lake, and pays no fee for this right, the rivers and lakes will be overfished to the point where the catch available to any fisherman is just worth his while to catch. Similarly, if anyone can swim in any river or at any beach free of charge, there will be overcrowding of swimming holes and beaches; and if anyone can use a freeway without paying for the facility of using it instead of more congested and slow alternative routes, there will be congestion on the freeways. Coase's more fundamental contribution was to show that if property rights are clearly defined and transactions in such rights have negligible costs, the private competitive market will bring the problems of pollution and environment destruction under appropriate social control.

To illustrate these points concretely: first, if everyone has the right to graze his goats on common land, or to cut down the trees on such land, it will pay everyone to use up the grass or the trees as long as the direct cost of so doing yields a net return, i.e., as long as there is enough grass left for a goat to survive and grow, or as long as there is enough timber standing to pay the costs of hiring loggers and their equipment. But it will never, or rarely ever, pay anyone to fertilize the soil and plant new grass for other people's animals to eat, or to replant timber for other people to cut. On the other hand, if one individual, or a collectivity of individuals, owned the land, it might or might not pay them to limit the number of goats being grazed, by either husbanding the goats themselves or charging a grazing fee for other people's goats, and to fertilize and seed the ground so as to maximize the profits they could make in the grazing business. Similarly, it might or might not pay them to replant the trees after they had been cut.

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[5] H.S. Gordon, The Economic Theory of a Common-Property Resource: The Fishery, *Journal of Political Economy*, Vol. 62 (April 1954), pp. 124 - 42; and R.H. Coase, The Problem of Social Cost, *Journal of Law and Economics*, Vol. 3 (October 1960), pp. 1 - 44

In either case, the replanting decision would be taken only if the result were to increase the value of the property by more than the cost of the replanting; and the private decision would correspond to the socially optimal decision. By analogy, a private owner of the environment would permit pollution of it only to the extent that the price paid for the right to pollute it exceeded the reduction in the value of the property as a consequence of the pollution itself. This is what happens, for instance, on a private farm: the farmer may set aside a piece of his property on which to dump trash or burn rubbish, thereby reducing his farmable acreage; and he may rent out the right to grow crops on some of his acreage. But he will, if he is rational, do so only if the overall effect will increase his standard of living, in the one case by disposing conveniently of his waste products, and in the other by increasing his cash income above what he could obtain by his own efforts.

The relevance to the problem of the environment is as follows. Much of the environment — the air, the water supplies, the unpopulated forests and mineral-producing regions — is regarded by society as a common property resource.

Everyone, whether poor or rich, is allowed to breathe the air and swim and fish in the rivers — or to discharge wastes into them. The use of forests and minerals, on the other hand, is controlled in a more or less vague way by the state, and the state is entrusted with the responsibility for administering the property. In the former case, there are no clearly defined property rights, only social assumptions about how and to what extent other people will use the common property resource. In the latter case, the state's property rights may be used to obtain short-sighted political advantages for the party in power, in the two senses that rights in the common property resource may be exchanged for bribes for the politicians, and that these rights may be transferred at a price below market value in order to provide employment and the promise of economic development for local citizens. In the former case, the absence of clearly defined property rights in the common property resource leads to what is regarded, on the one side of the argument, as pollution and, on the other, as a right of waste disposal necessary to efficient production. In the latter case, the willingness of government to dispose of natural resources at subsidized values leads to a loss of social capital, and the destruction of the environment in the genuine sense of a reduction of social wealth, instead of merely in the spurious sense of transformation of one specific kind of social wealth into another and more valuable kind.

Second, if property rights are clearly defined and transactions costs are negligible, the combined processes of private competition and legislation will arrive at the socially correct allocation of resources. Either my neighbor has the right to burn a fire whenever he wants and/or to pollute the local stream with the discharge of his wastes, in which case I must either live with the results (i.e., dry my laundry indoors or patronize a commercial laundry, or go dirty; fish at a

commercial trout stream or fish farm and install my own swimming pool, or do without the pleasures of fishing and swimming), or bribe him not to exercise his rights of pollution. Or else I have the property rights in the environment, and either he has to pay the costs of preventing himself from polluting my environment, or he has to bribe me to accept the pollution he wants to impose in order to save himself the costs. (Note, in the light of the preceeding argument, that I might be willing as a consumer to waive my property rights in consumption unpolluted by my neighbor in order to enjoy the benefits of high-paid employment in his productive but pollutant enterprises).

With a clear and all-embracing definition of private property rights and an inexpensive system of litigation, there would therefore be no substantive problem of pollution and of environment distribution. But property rights are not defined in such an all-embracing way; instead, they reflect past technologies which have made certain aspects of the environment valuable or otherwise. As example, mineral rights in coal and solid metals are fairly clearly defined as coterminous with surface acreage. Mineral rights in petroleum are not, nor are fishing rights, the latter because the seas used to be regarded as an inexhaustible resource and the former because farm locations and boundries are decided by surface and not sub-surface considerations of the distribution of natural resources. More important, the costs of property rights transactions — which include the costs of finding out with whom one needs to negotiate property rights are extremely high in a technologically advanced economy. It is easy enough to discover — though still expensive to litigate about — who has been diverting water away from one's river in order to irrigate his own fields, and whether he is entitled to do it. It is much more difficult and expensive to determine who has been polluting one's atmosphere, and what his rights to do so are as compared with one's own rights not to have one's air polluted. (The noise caused by supersonic jets poses an even more difficult problem.)

In circumstances of either high transactions costs, or ill-defined or undefined property rights or both, there will be, on the contrary, a tendency for pollution to reach a level beyond the socially optimum one, and correspondingly a case for government intervention of some sort to check it. More generally, whenever the total or social costs of some "good"— the private costs for labor, capital and materials that, say, a manufacturer pays in the market plus the costs that he does not pay for the uses of resources of, say, air and water to dispose of his residuals exceed the private costs, there will be a tendency to overproduce that "good" and overuse the free resources. The result is not only a higher than optimal level of pollution but an inefficient allocation of resources among competing uses. Metal cans, for example, may result in water pollution as the ore is mined, air and water pollution in the smelting and fabrication, and solid waste disposal requirements after use. If the costs of disposing of the residuals do not fall on the

producer and user, too many metal cans will be made and subsequently dumped, too much acid mine waste will go into streams, and too much smelter exhaust into the air.

Assuming that the normal mechanisms of property rights and litigation cannot be efficiently applied, there may then be a case for the government to use its coercive powers of taxation and prohibition of activities to improve the situation, but not always so, because the use of these powers also involves enforcement costs. However, and this is a crucial point, the socially optimal government policy does not generally consist solely in taxing the polluters of the environment, let alone in prohibiting any form of pollution as specified by the currently available technology and the current preference system. The optimal policy involves determining the socially optimal amount of pollution, and implementing a system of taxes on the gainers from pollution *and* subsidies to the losers from it accordingly in the light of some determination of what the fair distribution of property rights should be. As one of many conceivable examples, if a river is being polluted by paper-pulp production, prohibition of such production or insistence that pulp manufacturers use a nonpolluting technology (a form of tax on them) might well be socially less efficient than a smaller tax on pulp mills used to provide free communal parking, swimming pools, and fish ponds, since the former remedy might well benefit the aesthetically sensitive rich while depriving the poor of employment opportunities, while the latter would compensate the poor for pollution by providing equivalent free facilites for recreation.

As in the case of the farmer who sets aside part of his land for rubbish disposal, society will, if it is rational, incur costs for pollution abatement (whether in the form of higher taxes, higher prices, or loss of jobs and income) only to the extent that it improves its standard of living by eliminating "bads" whose value is at least as great as the costs of getting rid of them.

Society achieves a socially optimal amount of pollution when it is not willing to give up any further "goods" to achieve a further reduction of "bads." In this situation, intelligent public policy confronts two difficult tasks: determining the value society places on the "bads" inevitably associated with the production of "goods," and finding means to achieve the reduction of "bads" at the least cost in foregone "goods." Much of the debate over enviromental policy revolves around the varying assessments of different individuals and groups of the values of the "bads" resulting from economic activity and the differing mechanisms prescribed for reducing these "bads."

III. Economic Growth and the Envirnoment

As mentioned in the introduction, there have been flurries of popular concern about the effects of man, and specifically the expansion of man's numbers and the increase in his per capita production and consumption, on his environment and hence on his future prospects for well-being. This concern has arisen at various times in the contemporary (post World War II) period.

Population Growth and Food Shortage

Early in the postwar period, there was widespread concern along very orthodox Malthusian lines about a prospective shortage of food resulting from rapid rates of population growth in most parts of the world. As mentioned, this concern confused starvation with general poverty, rapid population growth helping to perpetuate the latter (where it exists) but not necessarily the former. Of greater practical importance, the "food alarmists" failed to take account of the possibilities of increasing agricultural production by developing and applying improved agricultural technology. These possibilities have been amply demonstrated since by the so-called green revolution, which has led to the appearance of embarrassing food surpluses in some regions or countries formerly regarded as famine prone. In any case, a prospective food shortage that actually began to manifest itself would do so through a general rise in food prices, which would call into play a wide variety of mechanisms that would tend to correct the situation. These would include, on the consumer side, a variety of substitutions of alternatives to food as a source of warmth (heating, warm clothing, etc.), more care in minimizing waste in the use of food (the "leftover" meal would come-back, as would "potluck," and food would be increasingly prepared in the household instead of in the factory), and substitutions toward the cheaper types of nourishment. On the producer side, there would be, in addition to the profitability-induced investment in superior agricultural technology just mentioned, a profitability-induced expansion of agricultural output in the two forms discussed by the classical economists — taking new and fertile land into cultivation, and working existing farmland more intensively.

It is important in this connection to note that in the developed countries there has been a general tendency toward withdrawing farmland from cultivation, as rising real wages made possible by economic growth have made farming unprofitable except on the most fertile lands using the most productive methods, and that this land could always be returned to cultivation if food prices became

high enough. It should also be pointed out that much cultivation is devoted to the production of crops other than foodstuffs, and that if food became sufficiently high-priced, land would be diverted from those other crops to food production. Finally, it should be noted that while an increase in food prices hits the poor and the lower-income groups hard, it touches the rich and the higher-income groups very lightly since the proportion of the budget spent on food falls as income rises ("Engel's Law"). Hence, it is nonsense to conjure up, as some of the population problem extremists have done, a vision of the world's population all starving to death simultaneously.

Economic Growth

More recently, concern has shifted from population growth to general economic growth as a source of alarm. Such concerns have varied in nature. A good many, in this writer's somewhat biased judgment, tend to reflect a conservative and aristocratic hankering after an earlier and simplier period of social organization in which people knew and kept to their place and upstarts could not become as affluent as oneself (or worse, destroy one's affluence) by making intelligent use of new resources and new technologies. In addition, some of this thinking is marked by strong undertones of anti-Americanism, both in general and reflecting the dislike of the rest of the world and for the disillusionment of American opinion with the War in Vietnam. One may cite John Kenneth Galbraith's olympian disdain for the failure of the United States to use its private affluence for public purposes (both to construct a nobler physical environment and to transfer income to the poor) and to make work more interesting to the worker; E.J. Mishan's obvious dislike of the fact that affluence allows the hoi polloi to enjoy the good things of life (the wonders of nature, privacy, etc.) formerly reserved for the few wealthier members of society, and hence to impair his own enjoyment of them by intruding on them; and the recently popularized idea that economic growth will destroy the ecology of the planet, which obviously involves a certain amount of covert anti-Americanism and a large amount of political conservatism. The extreme policy recommendation of "no (further) growth," which presumably would freeze everyone into his current position in the economic system, and among other things keep the rich countries rich and the poor countries poor, can hardly be interpreted as the voice of liberalism and democracy speaking.

A full discussion of all the issues raised by the critics of economic growth would require a book. Two issues seem worth detailed discussion here: the effects of economic growth on the quality of life, and the effects of growth on the "ecosystem" (the so-called coming ecological crisis). In each case, it is assumed for simplicity that the population problem can be ignored, and that economic growth is synonymous with rising income per head.

Growth and the Quality of Life

It must be recognized at the outset that the Gross Domestic Product (GDP) is a statistical measurement of a clearly specified and internationally standardized kind, and as such is not, and is not intended to be, a measure of national welfare; nor is GDP per head a measure of average individual welfare, nor the rate of growth of GDP per head a measure of improvement of average welfare over time. The GDP measures the market value of final goods and services produced by the economy (for growth calculations, the prices used are standardized on some base year, to isolate "real" growth of quantities from the effects on money prices of inflation or deflation and the effects of changes in relative prices). There are many things which affect the quality of life that do not pass through the market, for example, the by-product "bads" resulting from the production of "goods," and some of those that do pass through the market, such as the costs of police forces, social workers, and regulating departments of government of various kinds, should more properly be regarded as costs of the production of goods and services rather than as the production of goods and services themselves, though by stretching the imagination one might regard them as contributing to human welfare by reducing the production of "bads".

It must also be recognized that economic growth, especially in the contemporary form of large-scale industrial production and urbanization of the population, tends to increase the production of "bads" as well as of "goods."

Examples include the emergence of problems of fresh water supplies and of sewage and garbage disposal as cities grow in size and their residents wax more affluent and of atmospheric and water pollution as factory production per head rises. These are objective "bads"; but there are also subjective "bads" resulting from the fact that both people and their increasing affluence get in each other's way. An automobile is a great asset if I live in a modest-sized town where few other people have them, and I can use it to get quickly to and from work and to take myself and my family to isolated spots of natural beauty. It becomes less of an asset, perhaps even a liability, if I live in a large city where a lot of other people have one, I have to make my way to work through traffic jams and at considerable risk of accidents, and when I drive out to the country I have to find a parking place among the other sightseers and listen to their bawling children and their portable radios while I seek to commune with nature. Similarly, the occasional countryside shack representing rural poverty is not too much of an eyesore, and may even have a certain charm; a ghetto of people living the same way (though at what for them constitutes an improved standard of living) affronts my eyes and social conscience and may involve considerable danger to my life or my property.

That much being said, the opinion may be ventured that those who complain

most about the adverse effects of economic growth on the quality of life tend to start their complaints implicitly from an extremely egocentric view of society. This comes in two forms, one considerably more admirable than the other. The more admirable one consists of imaginatively putting oneself in the place of the lower and less affluent orders, and saying "I would not like to work in a factory turning bolts on an assembly line all day; and I would not like to spend all my evenings watching television in a tiny apartment or little suburban house. A society that makes people live that way is a very low-quality society, and if that is what economic growth produces I am against it." The egocentricity consists in assuming that because the way they live is unattractive compared with the way you live, it is less attractive to them than the way they would have to live if it were not for affluence and growth — which way would necessarily not be yours.

But the argument has an admirable side, in stressing that there is culture and there are higher standards of taste. What it overlooks is something that is reflected in many nineteenth-century novels about the *nouveaux riches*: they are as aware of their cultural poverty as are their social critics, but they have to learn for themselves how to improve their tastes and spending habits.[6] It betrays a great deal of unjustified pessimism about man as a social animal to assume that as he becomes more and more affluent he will become more and more of a pig. After all, our existing standards of culture, taste and the good life were built up by a discriminating use of their affluence by kings and nobles. If they could learn to use their money to support the arts rather than gluttony, drunkenness and lechery, why should the common man be different? And, in any case, why should he be deprived of the opportunity to try, by a forcible cessation of the economic growth that gives him that opportunity.

There is a further aspect to this subject. Some social critics, while pessimistic about the capacity of the lower-income groups to learn how to spend the rising income that economic growth brings them, would be quite happy and indeed anxious to transfer income to them provided that the ways in which it was spent were carefully supervised by the state. It is a fact that economic growth per se does very little to change the distribution of income in a more egalitarian direction, though it does accomplish something in this direction over time, largely by increasing the productive value of labor skills. Hence, economic growth is not an engine for producing economic equality, and there has been considerable despondency recently in less- developed countries about this fact.

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[6]In this connection, television in the United Kingdom particularly has been a powerful civilizing force; not only has it made the working-class home inhabitable by the family in the evening and virtually ended the pattern of the old man boozing at the pub in order to stay out of the presence of his wife and therefore an inevitable argument, but it has given the working class an insight (through both advertisements and films) into how more cultured people spend their money.

On the other hand, there are fairly strict political limits as to how far the high-income groups in an economically static society will tolerate fiscal redistribution of their incomes toward lower-income groups. And there is a fairly firmly established view among politicians in various countries that it is much easier to redistribute *increments* of income, which the nominal recipients will not miss, than *existing* income, which will force them to reduce their existing standards of living rather than merely their potential increase in standard of living. This may, of course, merely be a political myth, and it is clearly not a strong argument for government policies to raise the rate of economic growth by all available means, regardless of consequences for the environment and for the quality of life. But it is a serious qualification to the assertion that stopping or slowing down the rate of economic growth that the economy would otherwise produce would improve the quality of life, if "quality" is defined to include social justice in the personal distribution of income.

The less admirable form of egocentricity involves the complaint that other people's affluence reduces the value of one's own claim to the use of the environment ("public goods") and of one's own income. Well-paid jobs for them mean pollution of the rivers and the air for me, too many cars on the road for me to drive with the ease, speed and safety I would like, too many people on the top of a mountain I would like to stand on in splendid isolation. High incomes for them mean too many people competing with me for cheap personal service, and for tenancy of my cheap little flat in the center of London, or out-doing me in the kind of housing and household equipment I can afford. If I could just stop economic growth, I could preserve the public goods for the unrestrained enjoyment of people of taste like myself, and prevent these economic upstarts from competing away my comforts and my sense of social superiority.

Clearly, the argument that economic growth should be stopped in order to preserve the quality of my private life in terms of purchasing power over goods and services is too self-seeking to be given serious consideration. The argument about public goods, however, does have a kind of economic truth in it, if one divorces it from the argument that growth should be stopped in order to prevent others from causing congestion of facilities that I could previously enjoy in privacy. There is undoubtedly a tendency, as economic growth proceeds and affluence rises, for public goods to become overused and hence less enjoyable. But the proper remedy is not to stop growth and quash the possibility of affluence for those who have not yet enjoyed it, but to impose a charge for the use of the public good. If there are too many people climbing to the mountain top for those who get there to enjoy the view, ration access by charging a high enough fee to keep the numbers down. If water is being polluted by the by-product "bads" of goods production, tax production enough to make consumers pay for the damage their consumption of "goods" imposes on the unwilling

consumers of "bads." Similarly, if the roads get overcrowded, congested and dangerous, tax the owners of motor vehicles enough to achieve a combination of road provision and road usage that is socially optimal. (One can also throw in a system of establishing minimum safety standards for vehicles and their drivers and testing them regularly).

The central points here are that the "quality of life" in a growing society should not be left for evaluation to the self-interest of the already affluent in monopolized amenities, cheap labor service, and ostentatious charity, but should be judged by the quality of life for the not-yet-affluent. As general affluence increases, people gradually acquire higher standards both for their own private consumption and for the control of the use of public goods.

A poor society can afford to let a few habitual drunkards drive around in fast cars. As it gets more affluent, other people who can afford to buy cheap and unsafe cars are allowed the same privileges. As it becomes still more affluent, people become more and more conscious of the need for their own well-being of well constructed roads and the imposition of more stringent standards of driver and vehicle safety. Far from economic growth deteriorating the quality of life for the average man, it tends to improve that quality; but the process is one of learning better ways of doing things, and it frequently takes considerable time to appreciate what is vulgar, dangerous or antisocial about the old ways and what new ways will be more effective.

Growth and Resources

Concern about the effects of economic growth on the quality of life is a matter of taste and preference, and subject to argument on the grounds of whose taste, whose preferences and what time perspective is being asserted. Concern about the effects of economic growth on the ecology of the planet purports, at least, to be a matter of objective economic analysis. As such, it is essentially a more sophisticated version of Malthusianism, sophisticated by the recognition that the totality of natural resources, and not merely agricultural land, constitute the environmental capital with which man has to work, and that unlike agricultural land in the classical model many of these resources are depletable and will disappear in their original form as they are extracted from nature and employed in the productive process. But the assertion of a coming "ecological crisis" is as crude and unsophisticated in its economic analysis as the crudest form of Malthusianism, in neglecting the fact that manifest scarcities will give rise to price changes which, in turn, will promote substitutions in favor of cheap as opposed to expensive materials, products and forms of consumption, and the exploration of new technologies for transforming the environment into useful goods and services.

It should be noted that there are two crucial fallacies in the usual practice (which may be either statistically naive or statistically sophisticated) of projecting current rates of increase of usage of materials and energy sources provided by the environment into the future and comparing the results with presently known available supplies of these inputs. First, current rates of usage and rate of increase of usage reflect the current abundance and cheapness of the inputs in question. This, in turn, reflects current market conditions and expectations of future market conditions on the part of both private producers and users of these inputs, and the governments which frequently control access to these inputs.

Consumption of oil, for example, has been rising rapidly because oil has been a relatively cheap fuel; and it has been cheap partly because the governments of countries with proven oil supplies have been anxious to sell the fuel quickly, in order to cash in on their good fortune.[7] If it were known with certainty that oil would become extremely scarce in one or two decades, it would be advantageous for either the governments to keep their oil underground and borrow on the value of the asset, or for oil companies to buy up oil rights but keep the oil itself underground until the future had produced an increase in its value. It is economic nonsense to project rates of oil consumption on the basis of the effects of current low prices into a future when it is predicted that oil will become scarce. As it becomes scarce (assuming it does), oil prices will rise, oil reserves will be held for future profit rather than exploited immediately, substitutes for oil will be found, and the rate of increase of oil consumption, and perhaps even the absolute amount of oil consumption, will drop as a result.

Second, estimates of the availability of natural resources such as oil and other minerals are not made on a total, once-for-all, global inventory basis. Instead, they are largely the result of investments in exploration by private companies that wish to ensure themselves adequate supplies to meet future demand over a commercially reasonable period ahead, on the basis of existing technology and costs of production. Even where the exploration is undertaken by governments, the estimates are made in the light of existing technology and cost configurations. About 20 years ahead is the limit of worthwhile exploration of existing supplies, though the explorations sometimes turn up resources that might be commercially profitable with a sufficient increase in price or improvement of technology.

Estimates of this kind provide no basis for predictions that in 20 years' time the world will run out of oil, or iron, or whatever. By the time the 20 years have passed, either further exploration will have discovered a further 20 years' supply

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[7] The reader should note and consider the fact that even late in the nineteenth century approximately 80 percent of U.S. energy consumption was provided by burning firewood.

exploitable at the then prevailing prices and technology, or the price will have risen so much that other materials became dominant in the production process. These remarks simply illustrate the fallacies of applying arithmetic, whether crude or sophisticated, to an economic system in which the available factual information is itself generated by the economic processes of competition and growth, and hence represents no inevitability in the relationship between man and his environment. If man's economic system currently depends on an unsustainable rate of increase of production of oil, iron, hydroelectric power, or anything else, this does not mean that man is doomed to ecological disaster. It means only that the unsustainability of his present productive system will gradually communicate itself to him via the market system of changing prices reflecting changing relative scarcities, and that he will react both by developing new technologies for more efficient production of old inputs from the environment and by substituting new types of inputs, perhaps involving new technologies, for the old.

The process will definitely not be smooth, efficient and error-free; but there is no reason whatsoever to think that it will inevitably fail, and still less to think that it is imperative to avoid any possible risk by stopping economic growth in its tracks. In fact, one could argue the contrary: if man were compelled to live by his present technologies and their corollary definitions of the usable part of the environment, he might well run into disaster, because present technologies do involve the using up of certain depletable resources made available by the environment. It is only by switching to new technologies and the use of new resources from the environment that he can hope to maintain his present standard of living, let alone keep increasing it and improving his welfare. There is also the consideration that only as his standard of living rises can he afford to devote larger amounts of his resources to the preservation and improvement of that part of his environment that he considers valuable. It is the rich countries and not the poor ones that can afford to turn potentially valuable hunting, fishing and farming areas into game preserves and national parks, insist on industrial safety devices and the control of air pollution by smoke from factories, homes and automobiles, build safe roads and insist on safety in driving practices and automobile construction, and provide good housing, schooling and medical care to their poorer citizens.

To maintain that economic growth, and not the impediment or prohibition of it, is the way to betterment of the quality of life and the avoidance of ecological disaster, however, is not to deny that economic growth involves ecological problems. New technologies often have considerable side effects that might have been foreseeable if more time and effort had been put into studying them before

the new technologies were introduced. This is one of the major defects of the private enterprise system (although this term should be interpreted to include the entrepreneurial activities of governments as well) — that it emphasizes immediate benefits to the neglect of longer-run costs. Perhaps it is a defect attributable more fundamentally to the shortness of human life, and the even more abbreviated period during which human beings are entrusted by their fellow men with powers of economic and social decision making. Thus far, man has on the whole succeeded in remedying his errors in time, using the powers of public opinion and government to correct failures of the private competitive system to take account of all the relevant social considerations, especially as regards adverse effects of private competitive activity on the environment. But, as mentioned in an earlier section, the most advanced technologies, and specifically those that involve using the common property resources of the oceans and the atmosphere, may be perpetrating damage that is irretrievable.

We can replant forests, de-pollute water, rebuild our city centers, and re-landscape our suburbs and the scenery around our highways. What we cannot yet do is re-create extinct species of animals, birds and fish by laboratory methods, let alone reproduce valuable mental and physical characteristics of man himself. Nor is it yet established that we have the scientific capacity to remedy the damage we may be doing to our oceans and our upper atmosphere by treating both as a costless medium for the transport of people and goods, and the oceans as an inexhaustible source of fish and crustaceans for human nourishment.

It is in this direction, rather than in the direction of the conventional problems of population pressure and the destruction of the environment as conventionally conceived, that one must look for the genuine and difficult problems of the potentially adverse effects of man's activities on his environment.

London May 1973

A Commentary

By Frances Cairncross
to accompany a reissue of
'Man and His Environment' by Professor Harry Johnson
published by the BNAC in 1973

To those who have begun to think seriously about environmental issues only in the past few years, one of the most humbling realisations is that most of what is being said now was already said 20 years ago. Sometimes, it was said better. That is undoubtedly, and predictably, the case with Professor Harry Johnson's pamphlet. In a few brief pages, full of his pugnacious optimism, he gives a better beginner's guide to environmental economics than many written since.

Harry Johnson wrote his BNAC paper in 1973. The paper bears some of the hallmarks of its age. It is, for the most part, ferociously enthusiastic about the possibility of continued economic growth. Harry Johnson's interest in the environment was incidental to his economics, not central to it. Those non-economists whose interest in green issues springs from other sources will undoubtedly wince at his lusty faith in the ability of technology to solve most environmental problems. Increasingly it is clear that many kinds of damage to the environment are simply irreversible. Plenty of non-economists said that in 1973. More and more economists say it now.

Johnson's paper was written at much the high-water mark of the last tide of green concern. Three years earlier, the first 'World Earth Day' had seen massive environmental demonstrations right across the United States; the previous year, 1972, had seen the Stockholm Conference on the Human Environment, the first global environmental negotiations and the birthplace of the United Nations Environment Programme. The year of Stockholm was also the year of the famous Meadows report[1] which argued that economic growth was not, in the long run, compatible with the protection of the environment. The year of 1972 also saw the publication of Paul Erlich's 'The Population Bomb',[2] a flesh-creeping projection of the consequences of a continued acceleration in the growth of human numbers.

After 1973, the green tide began to recede. Green lobbying groups lost members and impetus: green issues gradually disappeared from the political agenda; most of the economists who had been interested in environmental issues began to turn their attention to other subjects. Why did interest fade? Partly, at

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[1] D.H. Meadows et al, 'The Limits to Growth', Universe Books, New York, and Earth Island Ltd, London. 1972 [2] Paul Erlich: 'The Population Bomb', Ballantine Inc; New York, 3rd Revised Edtion, 1986

least, because some of the glummest projections of environmentalists turned out to be wrong. "The Limits to Growth" had fretted about the exhaustion of non-renewable resources, such as oil and coal: in October 1973 OPEC raised the oil price and soon the world was plunged into a recession. Energy efficiency dramatically improved. As for population growth, it became clear by the end of the 1970s that a sharp change had taken place. In developing countries, the pace of growth was falling fast; in developed countries, birth rates were in sharp decline.

The preoccupation of the 1970s' environmentalists with population growth is reflected in the opening pages of Professor Johnson's paper. More remarkable than the popular panic of the time is Harry Johnson's calm confidence that "in due course, reproduction customs will become the same in the less-developed countries as economic opportunities and knowledge of opportunities and birthcontrol methods spread". Johnson was writing at the moment when the world's birth rate was rising faster than ever before, and indeed, had been accelerating for several centuries. It required monumental faith in human rationality to assert "it is not logical to make projections of the future on the assumption that population behaviour is completely independent of available resources and of human aspirations for improvement when a wide range of human history... points in the opposite direction."

Plenty of environmentalists today still believe that the pressure of population on food and other supplies of natural resources will eventually check economic growth. The Washington based Worldwatch Institute, for example, has repeatedly argued that soil erosion and diminishing returns on increasingly marginal supplies of new farm land will soon start to drive up world food prices, damaging economic growth even in countries that grow enough to feed themselves. Harry Johnson's reply is, in effect, "it's never happened yet". In the past, he argues, new technologies of food production (the tractor rather than the horse) and substitution for food (sedentary occupations that cut the need for energy) have allowed food supplies to keep pace with population. Indeed, the two decades after he wrote saw the fruits of the Green Revolution, allowing large parts of southeast Asia to become self-sufficient in food.

The view of the environment Prof. Johnson critises in his paper is essentially that of the greens who believe in conservation for its own sake. Tracing their intellectual pedigrees from writers such as Thoreau and John Muir, they argue that nature has an intrinsic value that has nothing to do with its use to human beings. It is worth, they claim, preserving untouched wilderness not because it gives people pleasure or has any particular use — but because the wilderness has the right to be left alone. Bill McKibben's recent book, 'The End of Nature', is the latest eloquent contribution to this school of thought.[3]

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[3] William McKibben: 'The End of Nature' Viking, London, 1990

Such "deep ecology" was utterly rejected by Professor Johnson. The value of the environment to society, he argued, is as a form of social capital. As with man-made capital, it must be managed if human beings are to derive maximum benefit. Good management can increase the economic value of the environment to humanity; bad management can reduce it.

Conservationists tend to see the environment as an absolute good; Professor Johnson, like most economists (even green ones), was more concerned to balance costs and benefits. He also argued that depletion of the environment can "generally (though not always)" be corrected subsequently by investment. Forests can be replanted; dead lakes revitalised by pumping oxygen into them.

Many arguments in environmental economics boil down to a question of faith in technology. The optimist says, "A technological fix will eventually allow us to solve this problem, as it has generally done in the past". The pessimist says, "Not all environmental problems have technological solutions". Professor Johnson was instinctively on the side of the optimists.

Today, fewer environmental economists would be so sanguine about technology. True, since Professor Johnson's day the most polluted of North America's Great Lakes have been reclaimed; the Thames has salmon in it once more; sulphur-dioxide emissions in the main industrial countries have strikingly declined. But interest has shifted from problems of domestic pollution of this kind to three other areas, where technology can do nothing to help. The most obvious example is the extinction of rare species. Clever science cannot recreate the dodo, and it will be no help in replicating the elephant. Indeed, most of the plants and insects threatened with extinction in the world's rainforests have not even been identified yet. No technical fix can bring back unknown beetles or mosses once they have vanished.

Secondly, there are pollutants that damage bits of the world that belong to nobody. One example: chloroflourocarbons (CFCs), chemicals used in refrigeration, in cleaning electronic components and in blowing foam are now believed to deplete the layer of stratospheric ozone, which shields the earth from some of the sun's ultra-violet rays and thus helps to protect people from skin cancer. Global warming, caused by gases that trap the sun's heat, is another. The trouble with such damage is not only that it is technically impossible to reverse; even if the technology existed, an unimaginable co-ordination of international effort would be needed to apply it. Indeed, one of the few new areas of thought that has developed in environmental economics since Professor Johnson's time has been the analysis of global problems of this sort. Economists and political scientists have done some work in the past on the co-ordination of macro-economic policies, and on defence; but no other international issue offers the complexity of global environmental pollution, with global causes and global effects. An international agreement to reduce the use of CFCs has been reached,

though many of the countries in which use is likely to grow most quickly havenot yet signed it. An agreement to tackle global warming will be very much harder to reach, let alone implement.

A third problem that may be beyond the comforting reach of technology involves those pollutants which accumulate over long periods of time with unknown but possibly dangerous effects. These include heavy metals (such as cadmium and lead), synthetic organic chemicals (such as PCBs) and nuclear waste. Here, economists increasingly see the need to find ways to accommodate uncertainty. If a scientist can say, with some certainty, how dangerous a particular process is, then an economist may be able to work out the cost. But with environmental science, the links between cause and damaging effect may be extremely unclear. The fall of the Newtonian apple may have been convincing proof of the existence of gravity; no such test is likely to demonstrate the links between - say - PCBs and cancer, or nitrogen in fertilisers and nitrates in the water supply. The guilt will always be by association. Moreover, the links may be non-linear: beyond a certain threshold, a substance may suddenly become much more damaging.

Since Professor Johnson's time, economists have got close to defining such difficulties, though little closer to solving them. Of these three "un-fixable" problems, Professor Johnson perceived and described the second two. He was canny enough to accept that by no means every bit of environment that was damaged has a ready cure or substitute. Even in such cases, though, he did not talk in green absolutes. Society, properly informed, had to trade off the prospect of incurring high environmental costs against the benefits of economic activity.

For — and this is an important insight — "pollution and production are joint products of man's efforts to transform his environment to his own use. It is rare that the process of satisfying man's wants by environment transformation can both leave intact the environment from which useful products are extracted, and yield only useful products and no pollutant by-products. The production and consumption of goods inevitably involves the production and consumption of 'bads' ".

With this paragraph, Professor Johnson cut to the root of much discussion of "green growth". It is simply not possible, except in rare circumstances, to have production without pollution. The key question is whether and how the consumers of "goods" are obliged to recognise the "bads" which are part of the package, and to pay the cost of the "bads" at the same time as consuming the "goods".

The divergence of private benefit from social cost — of private consumption of "goods" from public consumption of the accompanying "bads"— lies at the root of environmental problems. The market frequently fails, and when it does, the costs to society of exploiting the environment may outstrip the benefits from

such exploitation to private individuals. This market failure, with its accompanying external costs, is at the core of all economic discussions of environmental policy.

A main reason for the failure of the market to set proper costs on environmental damage is that much of what people think of as "environment" is nobody's property. Such "common property" — the sea, the atmosphere, the rain forest are all examples - can be used by almost anybody, at no charge. As a result, they are inevitably over-used. The sea is over-fished, the atmosphere polluted, the rain forest chopped down. Thirteen years before Professor Johnson wrote, another economist, R.H. Coase, had argued that, in certain circumstances, the most efficient cure for pollution was to establish property rights and then let the polluter and the sufferer bargain over the costs of the damage.[4]

A few economists (such as those at the American Enterprise Institute in Washington DC) still take the view that property rights are the best answer to most environmental problems. Harry Johnson was more subtle. He recognised that the costs of establishing property rights might sometimes be prohibitively high. It was one thing to trace the polluter to a river; quite another to find out who had polluted one's atmosphere. In such cases, the solution lay in government intervention. To make sure that private benefits take proper account of social costs may require the government to step in.

There have been, as it happens, a number of recent attempts to solve environmental problems by creating property rights. For instance, a Zimbabwean scheme to protect elephants involves giving local villagers the revenues from occasional culls and from organising hunting expeditions for tourists. A number of governments (most notably New Zealand) have tried to stop overfishing by giving fishermen the right to catch a certain quota of fish - and to sell that quota to other fishermen if they do not wish to use it. And in Colombia in 1989 a large tract of Amazon rain forest was made the legal property of the Indians who lived in it in an effort to improve conservation - and, incidentally, spot border incursions by Brazil.

But the development of ideas for allowing governments to apply concepts of property rights in environmental policy mainly came in the years after Harry Johnson wrote, with the development of ideas of tradeable pollution credits and resource quotas. Johnson's essay touched briefly on an older idea: that of pollution taxes, designed to ensure that polluters carry the social costs that they otherwise unload on others.

Interestingly, Professor Johnson insists that the optimal policy involved not just taxing the gainers from pollution, but subsidising the losers from it. Today's governments have already carried the debate on pollution taxes further than any

[4] R.H. Coase: The Problem of Social Cost. *Journal of Law & Economics*. Volume. 3 October 1960

1970s government would have dared. But so far, there has been relatively little argument over how the yield from pollution taxes might be spent. Certainly the British Treasury, which hates to see tax revenues ear-marked, would be uneasy with the idea that any cash from a pollution tax ought to be set aside to compensate losers. But society may instinctively agree with Johnson. A tax on cars, say, might be politically more acceptable if the revenue went to those who wait in bus queues or live along busy roads.

Of all environmental attitudes, none irritated Professor Johnson more than the green antipathy to growth. Such views, he claimed with typical brusqueness, "tend to reflect a conservative and aristocratic hankering after an earlier and simpler period of social organisation in which people knew and kept to their place and upstarts could not become as affluent as oneself (or worse, destroy one's affluence) by making intelligent use of new resources and new technologies." The "idea that economic growth will destroy the planet...involves a certain amount of covert anti-Americanism and a large amount of political conservatism," he added. Most of Europe's Green parties would wince to hear themselves described that way, but the picture has a strong resemblance to reality. Professor Johnson defended economic growth on two grounds: overall, it has improved the quality of people's lives; and it offers more hope of improving the quality of the environment than stagnation. Neither point is unqualified: he was frank about the drawbacks to growth. He was aware, for instance, that the "bads" that are produced at the same time as "goods" are not merely environmental - sewage, dirty air, contaminated soil and so on. They may be subjective, too. A car is a lovely thing to have if hardly anybody in the neighborhood owns one; less lovely once everybody sits in the same traffic jam. This idea, that the ultimate luxuries are goods and services which are necessarily restricted to a few people, was defined and expanded later in the 1970s by Fred Hirsch, who called them "positional goods".[5]

Harry Johnson pointed out, though, that rising prosperity undoubtedly caused public goods (quiet streets, lovely views, empty parks) to become more heavily used, and thus less enjoyable. The solution, he argued, was not to stop economic growth, but to impose a charge for the use of the public good. Tax the path to the mountain top, charge at the entrance to the park. Use the price mechanism to make growth greener. The deepest green economists today — people like Herman Daly, an American at the World Bank — do not believe that economic growth makes people "better off" in any meaningful sense.

All that is possible is to squeeze more human well being from a fixed stock of resources. Professor Johnson was more sanguine. His robust faith in technological salvation, delivered by the price mechanism, was founded on the

[5] Fred Hirsch: Social Limits to Growth, Routledge and Kegan Paul, London and New York 1977

experience of the past rather than fear of the future. But he ended his paper on a hesitant note. He returned again to the problems of irreversibility - the kinds of environmental damage for which technology has no answers. More tellingly, he paused to wonder about the capacity of private enterprise for taking proper account of long-term risks in a time of rapid technological change.

"One of the major defects of the private enterprise system...(is) that it emphasises immediate benefits to the neglect of long — run — costs. Perhaps it is a defect attributable more fundamentally to the shortness of human life, and the even more abbreviated period during which human beings are entrusted by their fellow men with powers of economic and social decision making".

Economists, like most of humanity, divide into optimists and pessimists. For pessimists, the study of the environment provides plenty of raw material, from the limited vision of elected politicians to the tendency of technology to go wrong. Optimists are harder to find. Professor Johnson's paper is a firm affirmation of faith in man's common sense, rationality, and ability to use technology wisely and inventively. Today, the pessimists have more adherents, and more to be pessimistic about. The interesting question posed by the final part of the paper is whether, had Johnson lived longer, even his robust enthusiasm for growth would have been tempered.

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